There are 30 questions in Section A and 15 questions in Section B.
The diagrams in this paper are not necessarily drawn to scale.
Choose the best answer for each question.

Section A

1. $8^{-674} \times 2^{2021} =$

   A. -2 .

   B. 0 .

   C. $\frac{1}{2}$.

   D. 2 .

2. If $\frac{a-3}{a+2} - b = 2$, then $a =$

   A. $-\frac{2b+7}{b+1}$.

   B. $-\frac{2b+5}{b-1}$.

   C. $\frac{2b-7}{b+1}$.

   D. $\frac{2b-5}{b-1}$.

3. Let p and q be constants. If $px(x+1) + 6x \equiv (q-1)x^2 + 2px$, then $q =$

   A. 2 .

   B. 4 .

   C. 6 .

   D. 7 .

4. $0.0393935 =$

   A. 0.040 . (correct to 2 decimal places)

   B. 0.0394 . (correct to 3 significant figures)

   C. 0.03940 . (correct to 4 decimal places)

   D. 0.039393 . (correct to 5 significant figures)

5. Let a_n be the nth term of a sequence. If $a_2 = 7, a_4 = 32$ and $a_{n+2} = a_{n+1} - 2a_n$ for any positive integer n, find a_7 .

   A. -124

   B. -60

   C. -4

   D. 46

6. The monthly salary of Alex is 20% lower than that of Sam while the monthly salary of Teddy is 20% higher than that of Sam. If the monthly salary of Teddy is \$14 400, then the monthly salary of Alex is

   A. \$9 600 .

   B. \$12 000 .

   C. \$13 824 .

   D. \$21 600 .

7. A sum \$20 000 is deposited at an interest rate of 4% per annum for 6 years, compounded quarterly. Find the interest correct to the nearest dollar.

   A. \$4 800

   B. \$5 306

   C. \$5 395

   D. \$5 441

8. It is given that z varies directly as the square root of x and inversely as the square of y. If x is increased by 44% and y is increased by 25%, then z

   A. is decreased by 76.8%.

   B. is decreased by 23.2%.

   C. is increased by 15.2%.

   D. is increased by 76%.

9. Let k be a constant. If $kx^2 - (k+3)x - 1 = 0$ has equal roots, then $x =$

   A. -9 .

   B. $\frac{1}{3}$.

   C. -1 or -9 .

   D. -1 or $\frac{1}{3}$.

10. If $f\left(\frac{x-1}{x}\right) = 3x^2 - 5x - 2$, then $f(2) =$

    A. -4 .

    B. 0 .

    C. 2 .

    D. 6 .

11. Let $g(x) = 2x^6 + ax^5 - 4x - 12$. If $g(x)$ is divisible by $2x + a$, find the value of a.

    A. -10

    B. -6

    C. 6

    D. 10

12. If $4 \leq x \leq 13$ and $-2 \leq y \leq 3$, then

    A. $1 \leq x - y \leq 10$.

    B. $1 \leq x - y \leq 15$.

    C. $6 \leq x - y \leq 10$.

    D. $6 \leq x - y \leq 15$.

13. Which of the following statements about a regular pentagon are true?

I. The number of folds of rotational symmetry is 5.

II. The number of axes of reflectional symmetry is 5.

III. The ratio of each interior angle to each exterior angle is $3 : 2$.

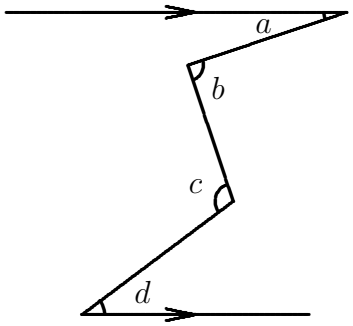
A. I and II only

B. I and III only

C. II and III only

D. I, II and III

14. In the figure, which of the following must be true?



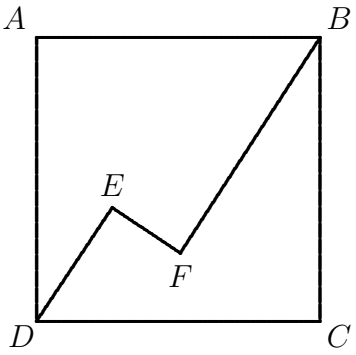
A. $a + b = c + d$

B. $a + c = b + d$

C. $a + d = b + c$

D. $a + b + c + d = 360°$

15. In the figure, $ABCD$ is a square. If $\angle DEF = \angle EFB = 90°, DE = 6, EF = 4$ and $FB = 22$, find AB.



A. 20

B. 21

C. 28

D. 30

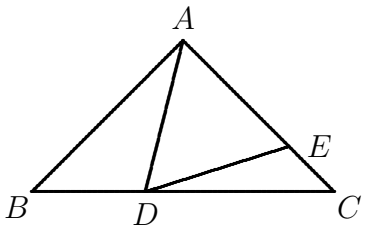
16. In the figure, $\triangle ABC$ is an isosceles triangle, where $AB = AC$. D is a point on BC such that $\angle ABD = \angle ADE, BD = 10$ cm and $CD = 20$ cm. E is a point on AC such that $CE = 8$ cm. Find the length of AB.

A. 16 cm

B. 20 cm

C. 25 cm

D. 30 cm



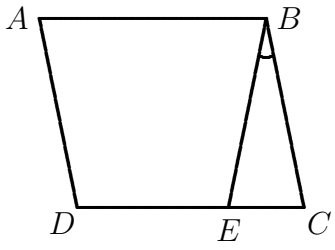
17. In the figure, $ABCD$ is a parallelogram. E is a point on CD such that $BE = BC$. If $\angle ADC = 122°$, then $\angle CBE =$

A. $29°$.

B. $58°$.

C. $61°$.

D. $64°$.



18. If the volume of a solid hemisphere is 18π cm^3, then its total surface area is

A. 18π cm^2 .

B. 27π cm^2 .

C. 36π cm^2 .

D. 45π cm^2 .

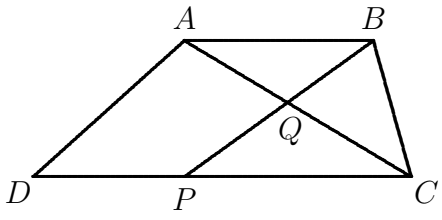
19. In the figure, $ABCD$ is a trapezium with $AB//DC$ and $AB : DC = 1 : 3$. P is a point lying on DC such that $DP : PC = 4 : 5$. AC and PB intersect at Q . If the area of $AQPD$ is 282 cm^2, then the area of $\triangle ABQ$ is

A. 36 cm^2 .

B. 48 cm^2 .

C. 54 cm^2 .

D. 90 cm^2 .



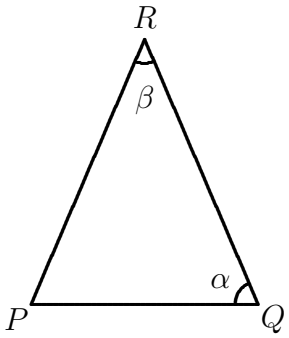
20. In the figure, if $PQ = 1$, then the area of $\triangle PQR$ is

A. $\dfrac{1}{2}\sin\alpha\sin\beta\sin(\alpha+\beta)$.

B. $\dfrac{\sin\alpha\sin\beta}{2\sin(\alpha+\beta)}$.

C. $\dfrac{\sin(\alpha+\beta)}{2\sin\alpha\sin\beta}$.

D. $\dfrac{\sin\alpha\sin(\alpha+\beta)}{2\sin\beta}$.



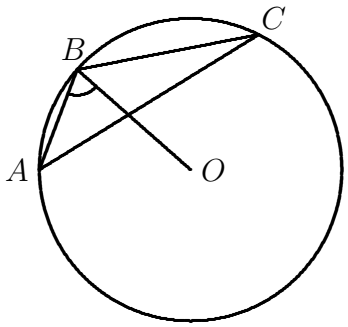
21. The figure shows a circle ABC with centre at O. If $\angle ACB = 10°$, then $\angle ABO =$

A. $50°$.

B. $70°$.

C. $80°$.

D. $100°$.



22. In the figure, the equations of L_1 and L_2 are $ax+by = 1$ and $x+cy = d$ respectively. Which of the following must be true?

I. $a > 0$

II. $c + d < 0$

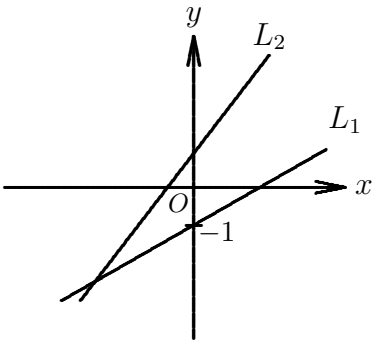
III. $ac < b$

A. I and II only

B. I and III only

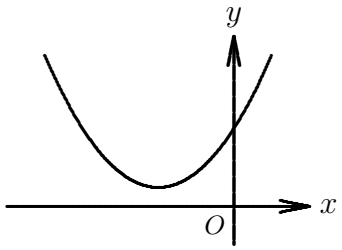
C. II and III only

D. I, II and III

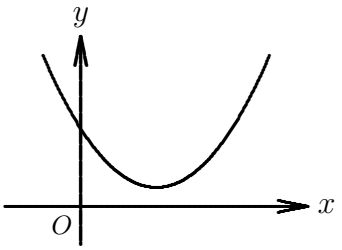


23. If $-1 < k < 0$, which of the following may represent the graph of $y = (kx + 1)^2 + k$?

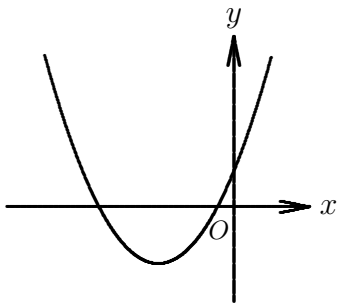
A.



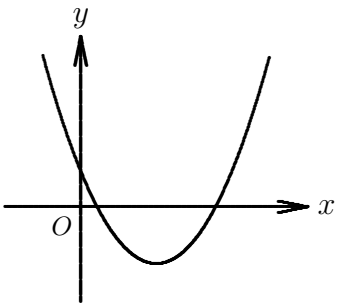
B.



C.



D.



24. If the straight lines $L_1 : x + 3y - 3 = 0$ and L_2 are perpendicular to each other and intersect at the y-axis, find the equation of L_2.

A. $3x - y + 1 = 0$

B. $3x - y + 3 = 0$

C. $3x + y - 1 = 0$

D. $3x + y + 3 = 0$

25. The coordinates of A and B are $(2, 3)$ and $(7, 15)$ respectively. If P is a moving point in the rectangular coordinate plane such that P keeps a fixed distance of 3 units from the line segment AB, then the area of the region bounded by the locus of P correct to the nearest integer is

A. 67 square units.

B. 106 square units.

C. 152 square units.

D. 191 square units.

26. A circle passes through the origin and intersects the negative x-axis and the positive y-axis at points A and B respectively. If $OA : OB = 4 : 3$ and the radius of the circle is 5, find the equation of the circle.

A. $x^2 + y^2 - 4x + 3y = 0$

B. $x^2 + y^2 + 4x - 3y = 0$

C. $x^2 + y^2 - 8x + 6y = 0$

D. $x^2 + y^2 + 8x - 6y = 0$

27. In a test, the mean scores for boys, for girls and for the whole class are 68, 80 and 70.4 respectively. Find the ratio of the number of girls to the number of boys.

A. $1 : 4$

B. $2 : 3$

C. $3 : 2$

D. $4 : 1$

28. David has 4 cards numbered 1, 4, 7, and 9. He randomly draws 2 cards at the same time, what is the probability that the sum of the numbers drawn is a prime number?

A. $\frac{1}{4}$

B. $\frac{1}{3}$

C. $\frac{1}{2}$

D. $\frac{7}{12}$

29. Consider the data set $\{1, 2, 3, 5, 7, 10, 11, 13, x, y\}$. If x and y are positive integers and the median of the data is 6, find the least possible value of the mean of the data set.

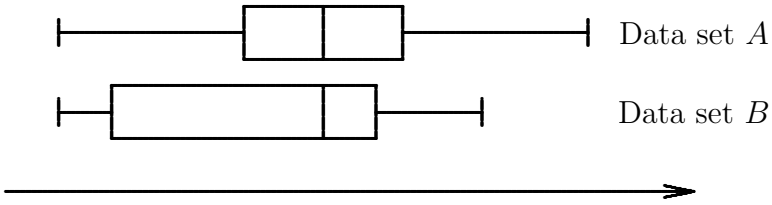
A. 5.3

B. 5.8

C. 5.9

D. 6

30. Consider the following box-and-whisker diagrams.



Which of the following must be true?

I. The mean of data set A is equal to that of the data set B.

II. The inter-quartile range of the data set A is less than that of the data set B.

III. The range of the data set A is not less than that of the data set B.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

Section B

31. $AB0000002021_{16} =$

A. $10 \times 16^{11} + 11 \times 16^{10} + 8225$.

B. $10 \times 16^{12} + 11 \times 16^{11} + 8225$.

C. $11 \times 16^{11} + 12 \times 16^{10} + 131600$.

D. $11 \times 16^{12} + 12 \times 16^{11} + 131600$.

32. If x and y are real numbers such that $y + i = 2 - \dfrac{x - yi}{3}$, then $x + y =$

A. 0 .

B. 1 .

C. 6 .

D. 12 .

33. If $m \neq n$ and $3m - 2m^2 = 3n - 2n^2 = 9$, find $\left(\dfrac{n}{m} - n\right)\left(\dfrac{m}{n} - m\right)$.

A. $-\dfrac{4}{3}$

B. $\dfrac{10}{3}$

C. 4

D. 7

34. In an arithmetic sequence, the first term is 85 and the common difference is an integer. The sum of the first n terms of the sequence has the greatest value when $n = 9$. Find the common difference.

A. -11

B. -10

C. -9

D. -8

35. Amy borrows \$40 000 from a bank at an interest rate of 7% p.a. compounded yearly. Starting from the end of the first year, she repays \$6 000 to the bank every year. How many years later can she repay all the money to the bank? (The last instalment may be less than \$6 000.)

A. 8 years

B. 9 years

C. 10 years

D. 11 years

36. Consider the following system of inequalities:

$$\begin{cases} x \geq 0 \\ y \geq 0 \\ x + y \leq 3 \\ x + 2y \geq 4 \end{cases}.$$

Let R be the region which represents the solution of the above system of inequalities. If (x, y) is a point lying in R, then the least value of $2x - y$ is

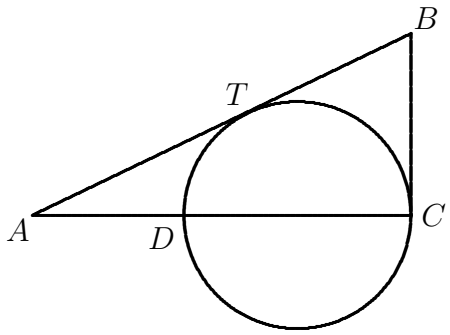
A. -3 .

B. -2 .

C. 3 .

D. 6 .

37. In the figure, CD is a diameter of the circle CTD. AB and BC are tangents to the circle at T and C respectively. If $AD = 4, AT = 8$, then $BC =$



A. 6 .

B. 8 .

C. 12 .

D. 20 .

38. The coordinates of the points A and B are $(0, 6)$ and $(36, -12)$. If C is the reflection image of B with respect to the line $y = 2$, find the x-coordinate of the orthocentre of $\triangle ABC$.

A. 24

B. 29

C. 31

D. 33

39. If the straight line $x - y = 5$ and the circle $x^2 + y^2 - 3x + 5y + 6 = 0$ intersect at A and B, then the y-coordinate of the mid-point of AB is

A. -6 .

B. -3 .

C. 2 .

D. 4 .

40. For $0° \leq x < 360°$, how many distinct real roots does the equation $\sin x = \tan x$ have?

A. 2

B. 3

C. 4

D. 5

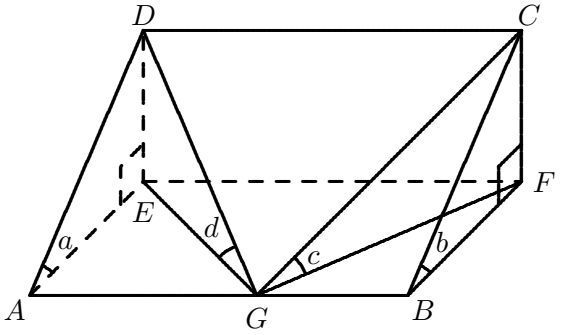
41. The figure shows a right prism $ABCDEF$ with a right-angled triangle as the cross-section. A, B, E and F lie on the horizontal ground. G is a point lying on AB. Let $\angle DAE = a$, $\angle CBF = b$, $\angle CGF = c$ and $\angle DGE = d$. If $\angle AEG = 45°$ and $\angle FGB = 30°$, which of the following is true?

A. $a > c > d$

B. $a > d > c$

C. $c > b > d$

D. $c > d > b$



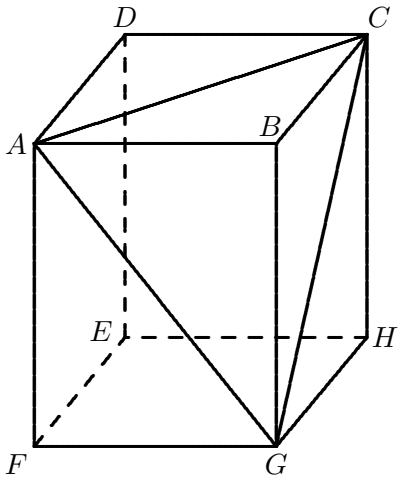
42. In the figure, $ABCDEFGH$ is a cuboid. $\angle AGB = 30°$ and $\angle CGB = 20°$. Find $\angle AGC$ correct to the nearest degree.

A. 36°

B. 42°

C. 47°

D. 50°



43. In a competition, Albert plays against Billy in the semi-final. The winner will play against Calvin in the final. The probabilities that Albert wins Billy, Calvin wins Albert and Calvin wins Billy are $0.6, 0.55$ and 0.6 respectively. Given that Calvin loses the competition, find the probability that Albert wins in the final.

A. $\frac{27}{200}$

B. $\frac{9}{20}$

C. $\frac{9}{17}$

D. $\frac{27}{43}$

44. There are 15 girls and 12 boys in a class. If a group of 5 students is selected from the class to participate in a performance show and the group consists of at most 2 girls, how many different groups can be formed?

A. 8217

B. 23100

C. 31317

D. 49413

45. A set of data has a median of 25, an interquartile range of 18 and a variance of 16. If 5 is subtracted from each datum in the set and each resulting number is then tripled to form a new data set, find the median, the interquartile range and the variance of the new set of data.

	Median	Inter-quartile Range	Variance
A.	60	39	144
B.	60	54	48
C.	60	54	144
D.	75	39	48

END OF PAPER